Tutorial
H-1000-5312-01-A

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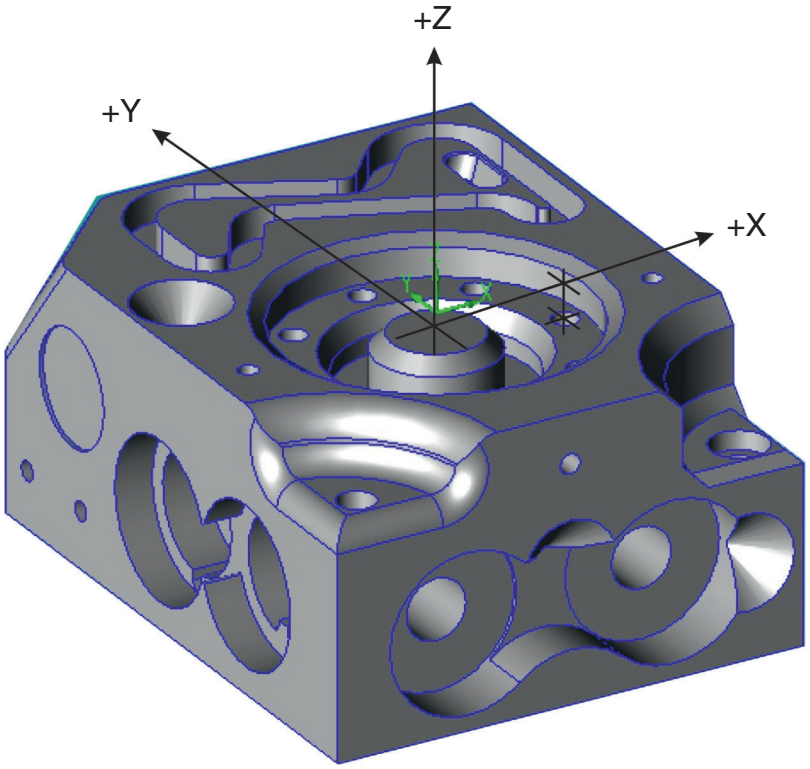
Part alignment - plane and two circles (non-CAD)



Renishaw part no: H-1000-5312-01-A

Issued: 12 2013

Part alignment - plane and two circles (non-CAD)

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Contents

1 Part alignment - plane and two circles (non-CAD)

1.1 Tutorial pre-requisites

- The student should understand ‘Principles of part alignment’
- The student should have covered ‘Part alignment - plane, line and point’

1.2 Tutorial objectives

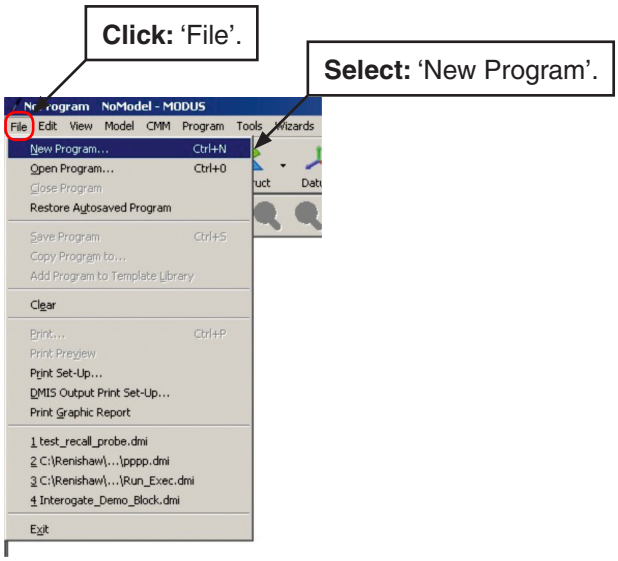
- Introduction to feature constructions
- Understand alternative part alignment options

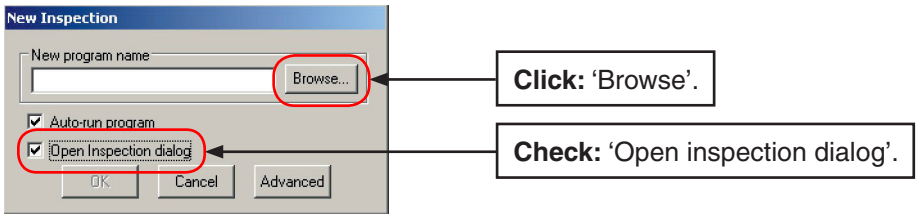
2 Introduction

In this tutorial, the Renishaw training block will be used to simulate part alignment requirements controlled by a central boss / bore and timing feature (e.g. a rotating part).

3 Create a new program

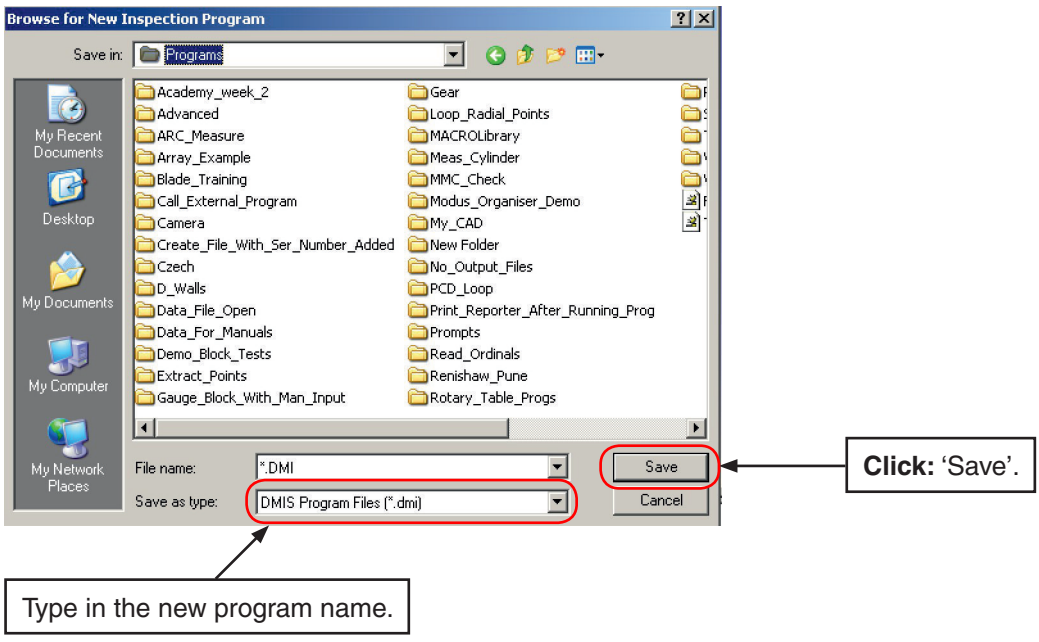
Before measurements can be made a program must be created.



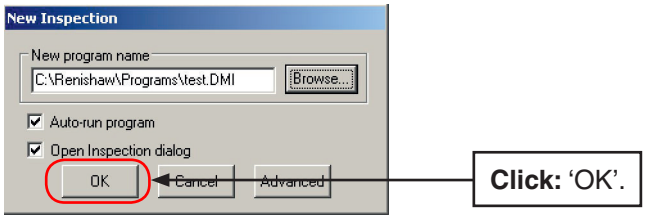


This will allow settings to be confirmed before the program is created,

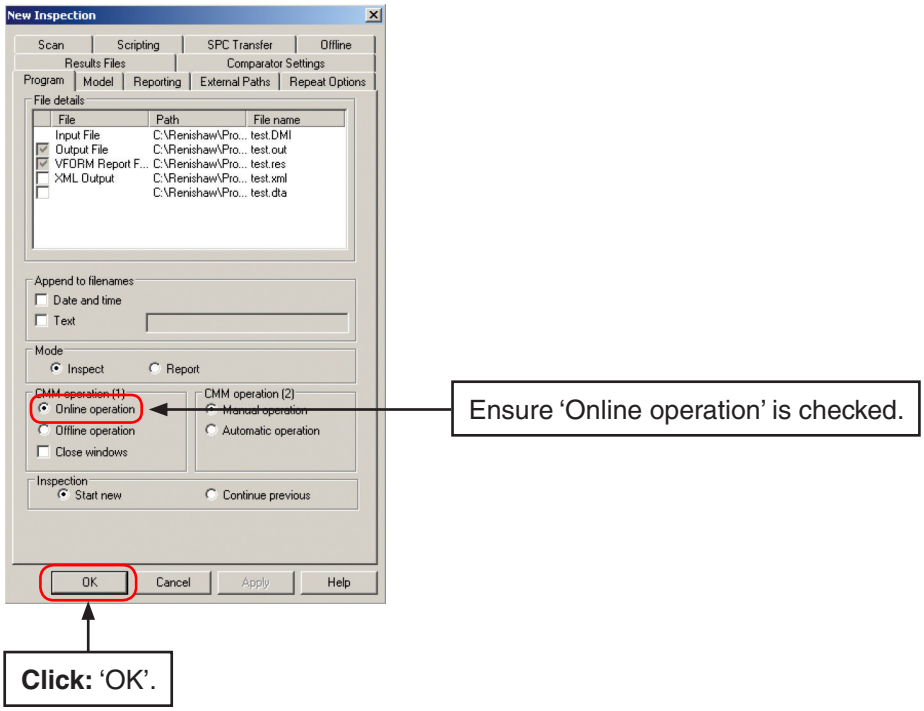
After clicking ‘Browse’, select a suitable location for the program:



GUIDANCE NOTE: It is recommended that the new program be placed in its own folder. This will make it easier to locate related files that are generated during programming / measurement output.

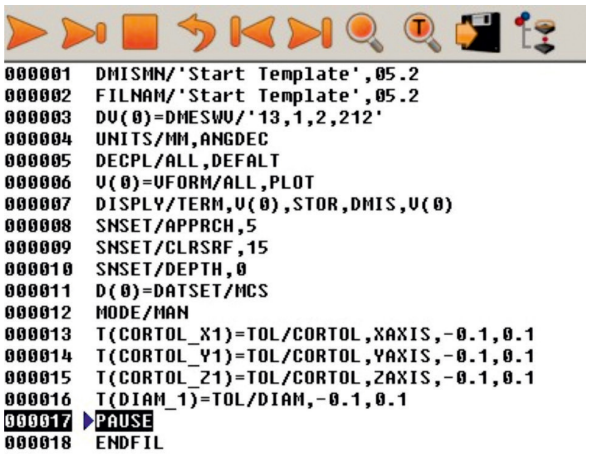


The 'New Inspection' dialogue will now open:

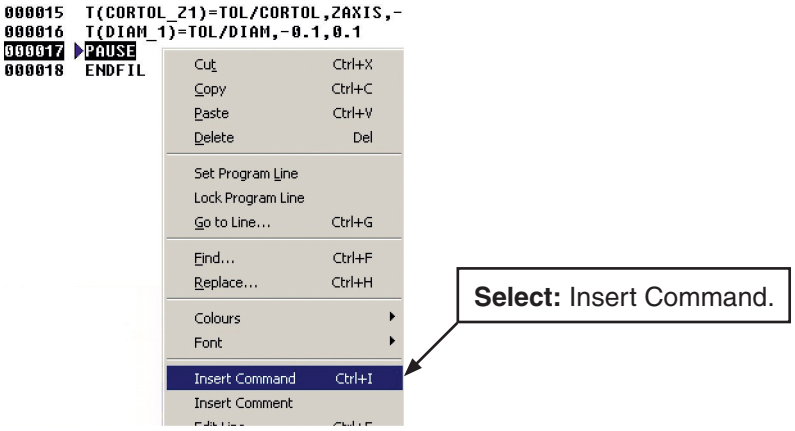


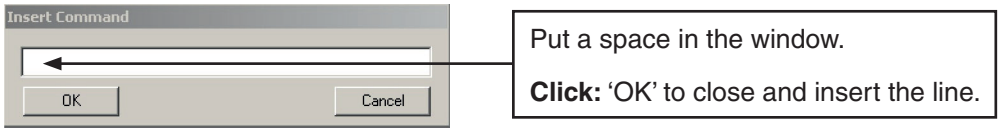
GUIDANCE NOTE: Further information on this dialogue window will be provided later in the 'Basic options within the new inspection dialogue' tutorial.

The following header will be inserted into the program:



To insert some line spaces to make the program easier to read, right mouse click on the line containing the 'Pause' command:



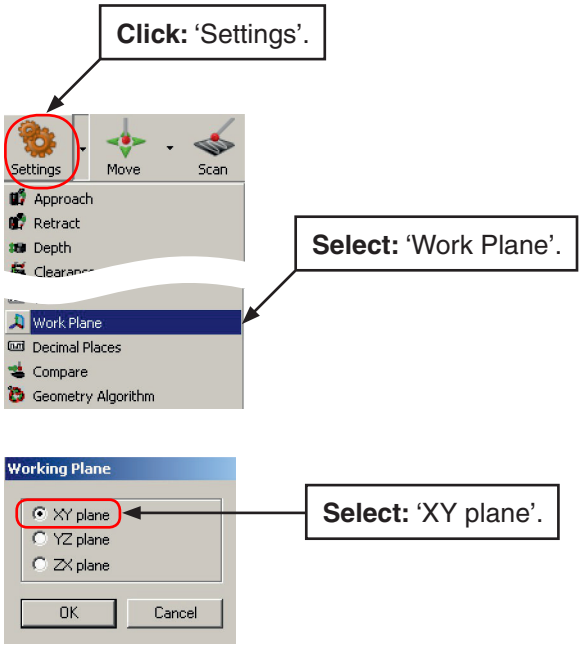


The line is inserted above the line that was selected.

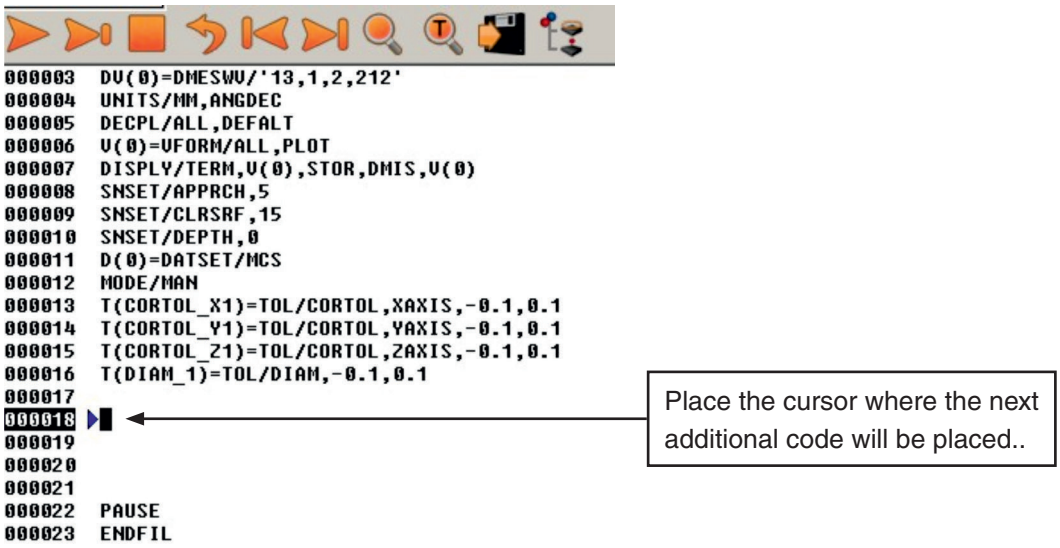
Add more spaces as required.

```
000008  SNSET/APPRCH,5
000009  SNSET/CLRSRF,15
000010  SNSET/DEPTH,0
000011  D(0)=DATSET/MCS
000012  MODE/MAN
000013  T(CORTOL_X1)=TOL/CORTOL,XAXIS,-0.1,0.1
000014  T(CORTOL_Y1)=TOL/CORTOL,YAXIS,-0.1,0.1
000015  T(CORTOL_Z1)=TOL/CORTOL,ZAXIS,-0.1,0.1
000016  T(DIAM_1)=TOL/DIAM,-0.1,0.1
000017
000018
000019
000020
000021
000022  PAUSE
000023  ENDFIL
```

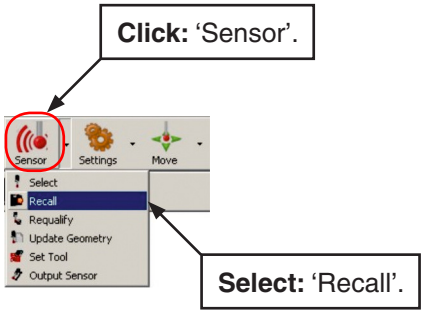
Next define the work plane that contains the features that will be measured:



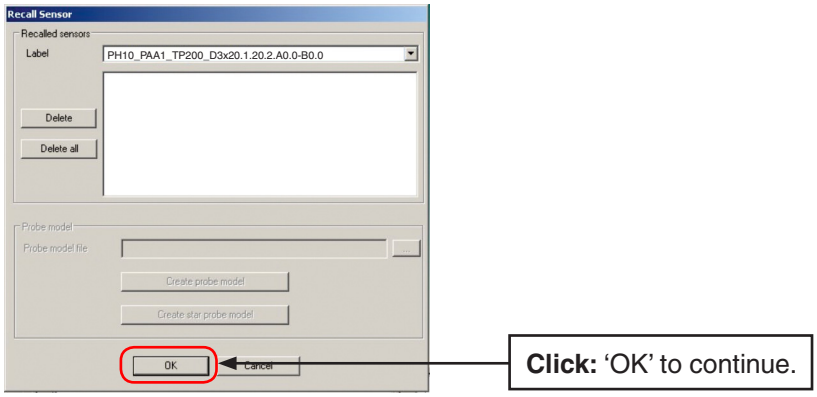
GUIDANCE NOTE: It is particularly important to define a work plane when working in polar coordinates because it defines which plane will use the polar coordinate system.



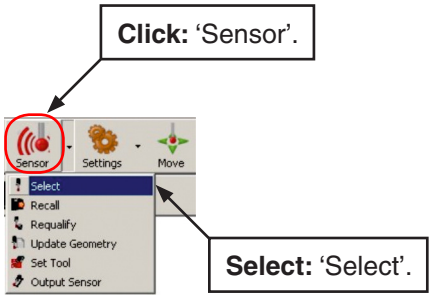
Before sensors can be selected they must have been recalled into the part program. To recall the tool:



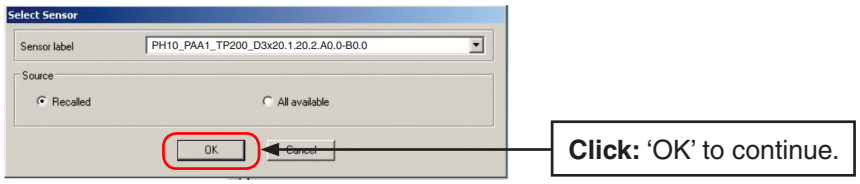
Select the appropriate tool from the drop down menu.



The sensor can now be selected. To select the tool:



The tool should be displayed in the window, if not, select it from the drop down menu.




```
000012  MODE/MAN
000013  T(CORTOL_X1)=TOL/CORTOL,XAXIS,-0.1,0.1
000014  T(CORTOL_Y1)=TOL/CORTOL,YAXIS,-0.1,0.1
000015  T(CORTOL_Z1)=TOL/CORTOL,ZAXIS,-0.1,0.1
000016  T(DIAM_1)=TOL/DIAM,-0.1,0.1
000017
000018  RECALL/SA(PH10_PAA1_TP200_D3x20.1.20.2.A0.0-B0.0)
000019  SNSLCT/SA(PH10_PAA1_TP200_D3x20.1.20.2.A0.0-B0.0)
000020
000021
000022
000023  PAUSE
000024  ENDFIL
```

The program will now have two additional lines which recalls and selects the tool.

Feature measurement can now take place.

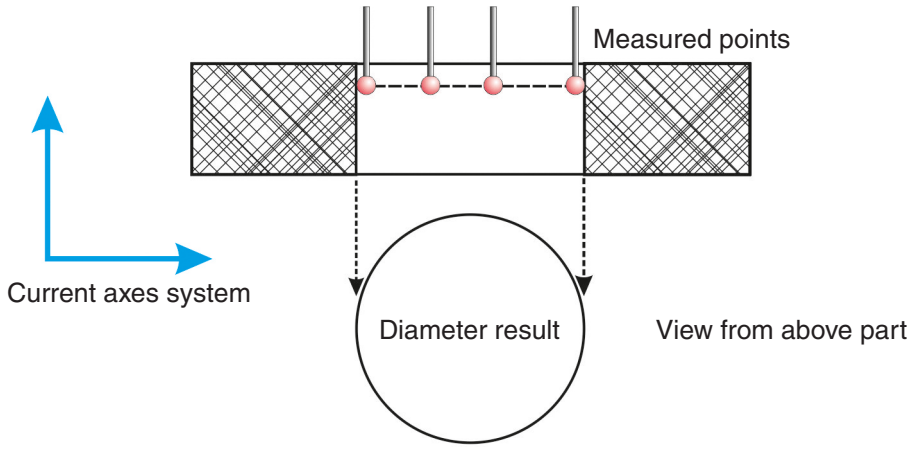
4 Measure a plane and two circles

Before any meaningful measurement is made on a part it must first be ALIGNED.

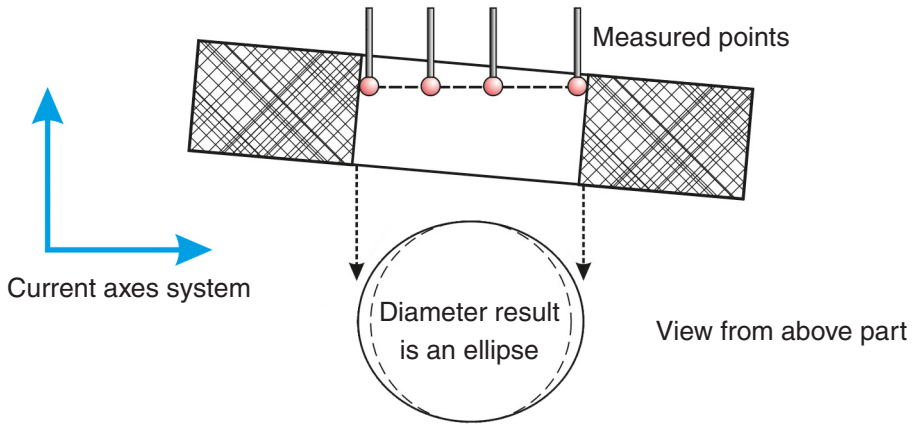
This must be done as the part will not be sitting square to any axis of the CMM and therefore will be generating errors that do not exist into the measured results.

A good example of this is shown below where the effects on an UNALIGNED part can be seen.

GOOD - The part has been aligned:

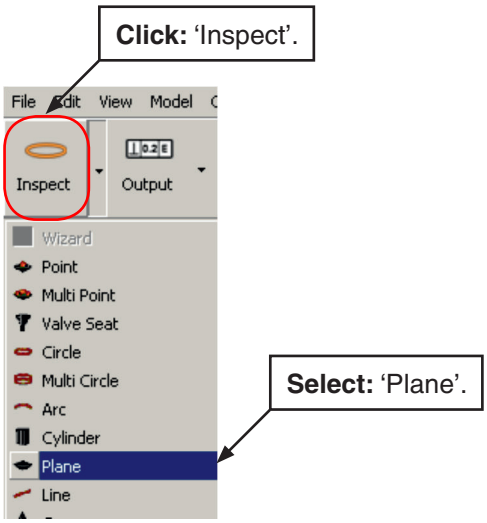


BAD - The part has NOT been aligned:

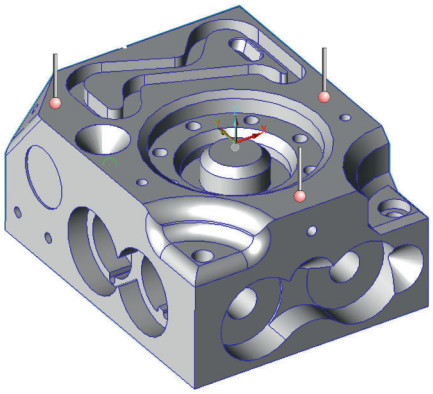


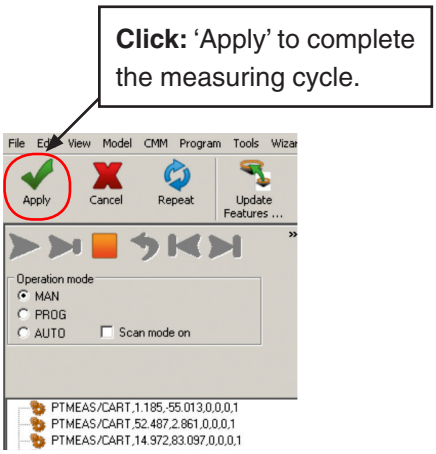
As can be seen the result of an unaligned or badly aligned part will result in an ELLIPSE and not a CIRCLE as required.

Firstly, the top face of the training block will be inspected as a plane.

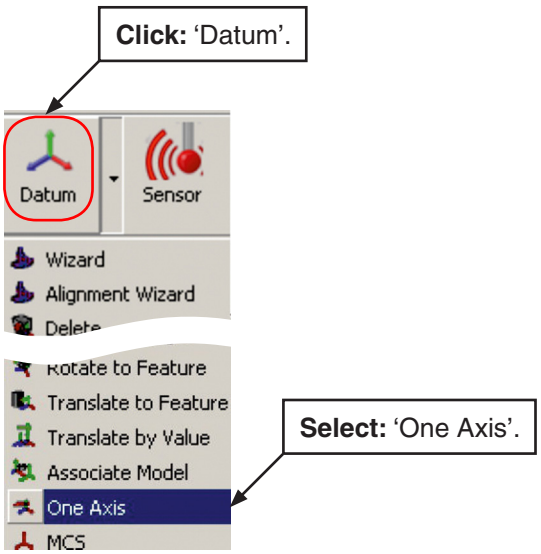


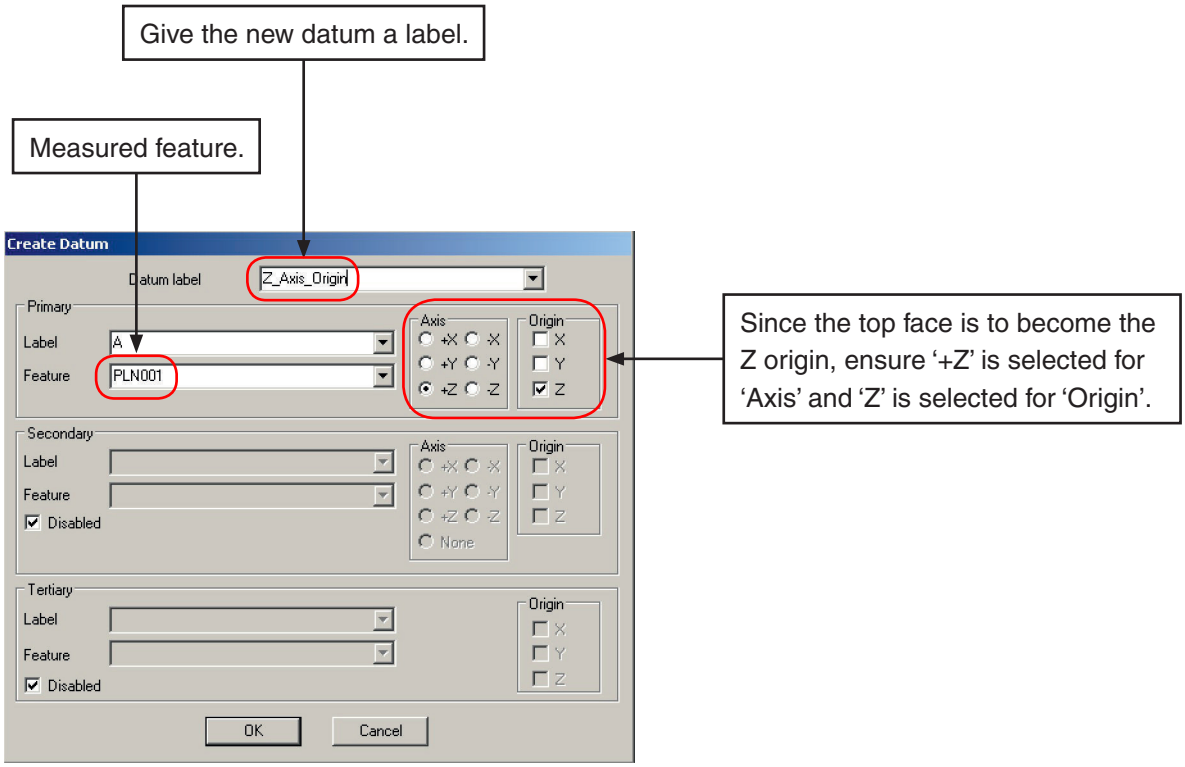
Take a minimum of three points on the plane:





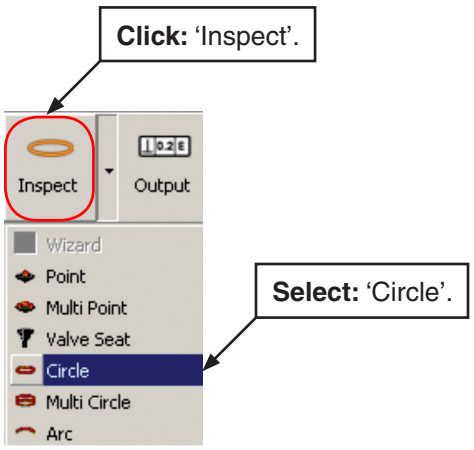
To create a primary axis on this feature click 'Datum' then select 'One Axis':



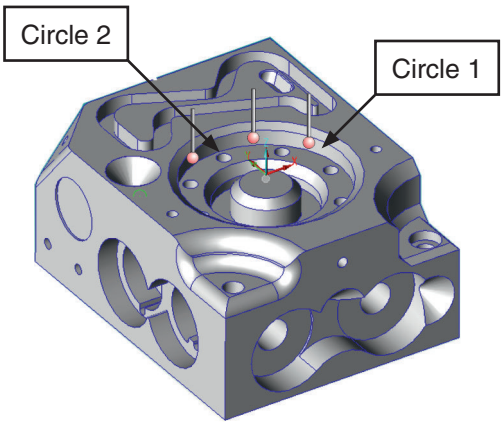


GUIDANCE NOTE: The secondary and tertiary panes are unavailable because 'One Axis' datum was selected.

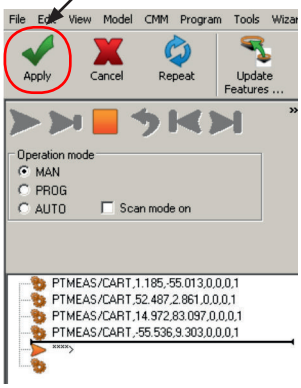
To fully constrain the part, two circles will also be inspected.



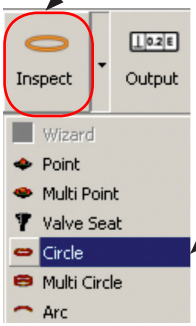
Take a minimum of three points in circle 1:



Click: 'Apply' to complete the measuring cycle.

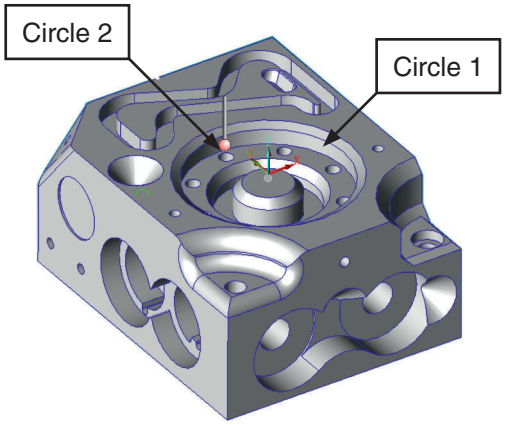


Click: 'Inspect'.

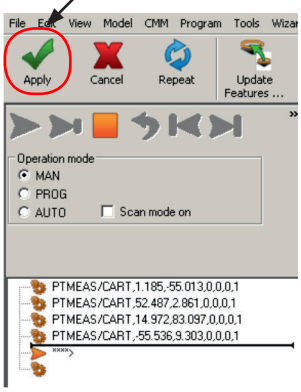


Select: 'Circle'.

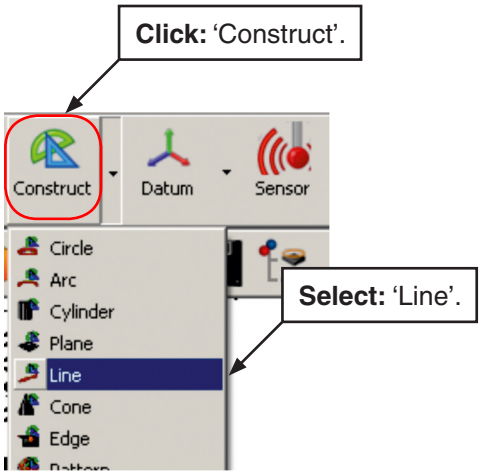
Take a minimum of three points in circle 2:

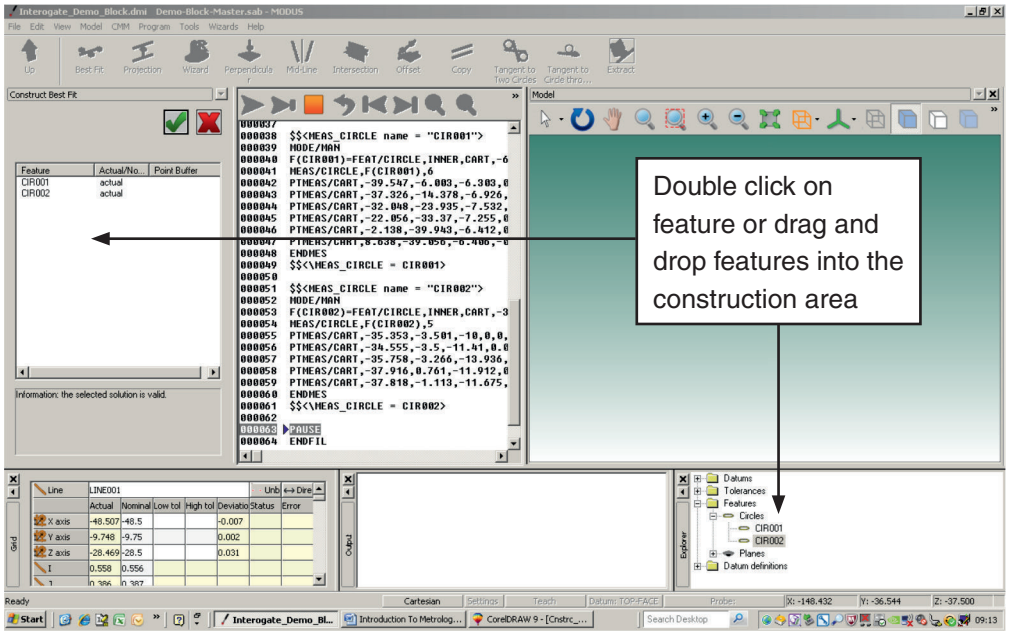


Click: 'Apply' to complete the measuring cycle.



To create a feature that can be used to lock the rotation (about Z) of the component, a line will be constructed between the centres of the two measured lines.





GUIDANCE NOTE: Make a note of the order the holes have been inserted in the construction window:

i.e. CIR001 to CIR002 will give a positive direction, and CIR002 to CIR001 will give a negative direction.

This is important when selecting the axis direction for alignment.

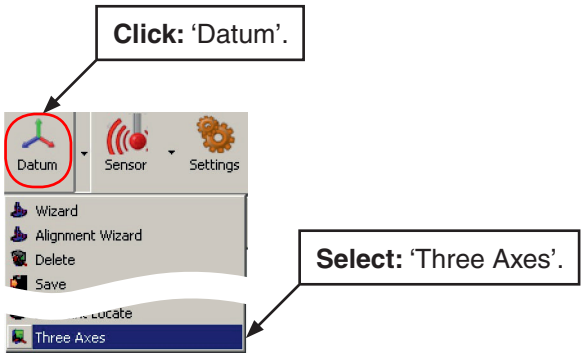
Click: 'Apply' to complete the construction cycle.

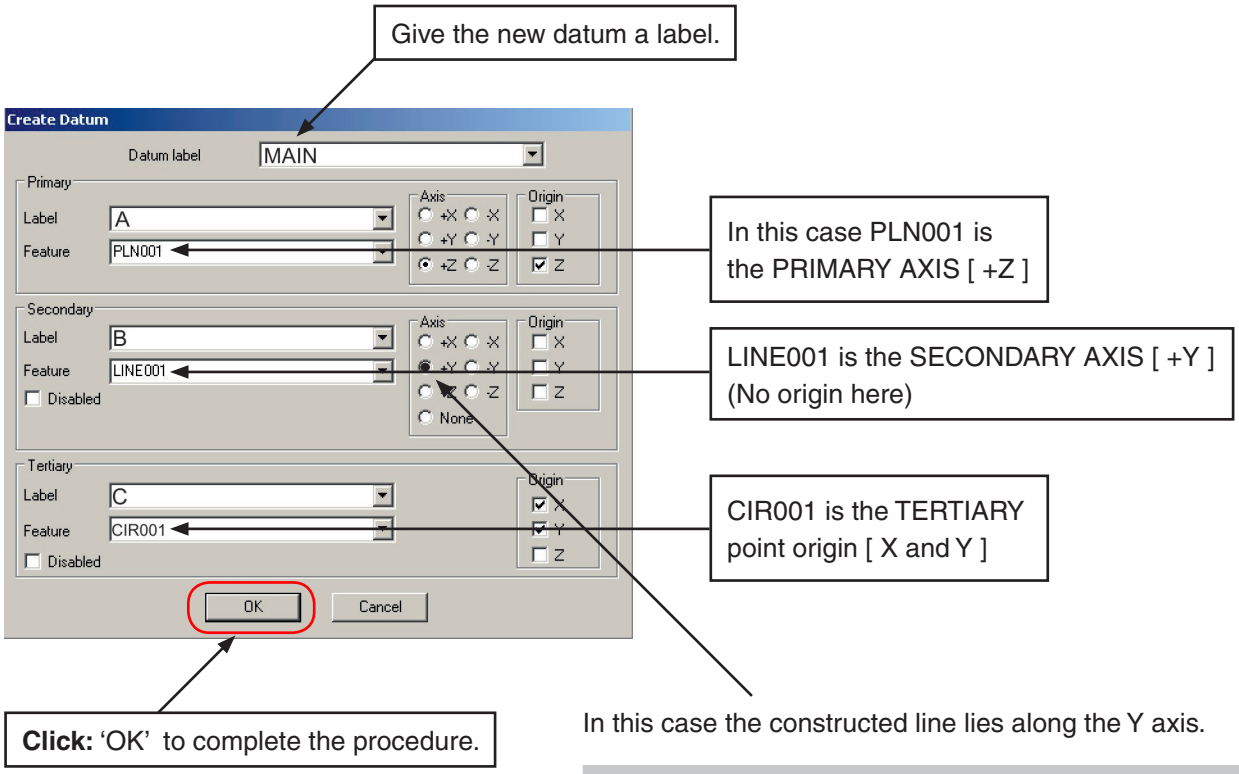
Code Produced :-

F(LINE001)=FEAT/LINE,UNBND,CART,57.5,20.13,-40,0,-1,0,-1,0,0
CONST/LINE,F(LINE001),BF,FA(CIR001),FA(CIR002)

5 Defining primary, secondary and tertiary datums

There are now enough features to create a datum.

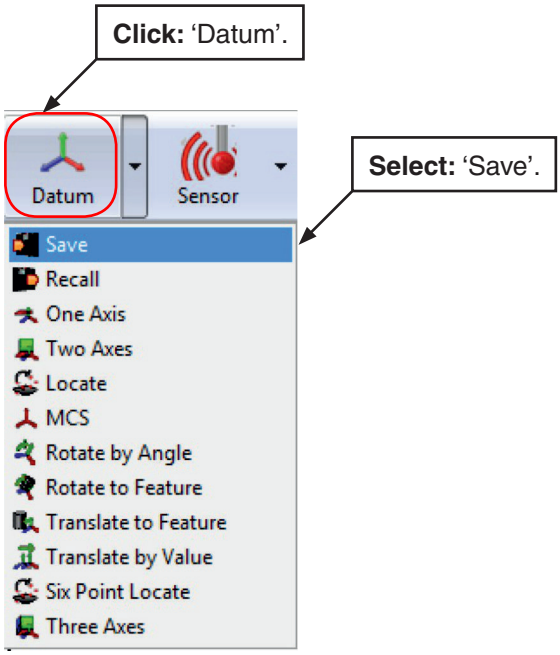


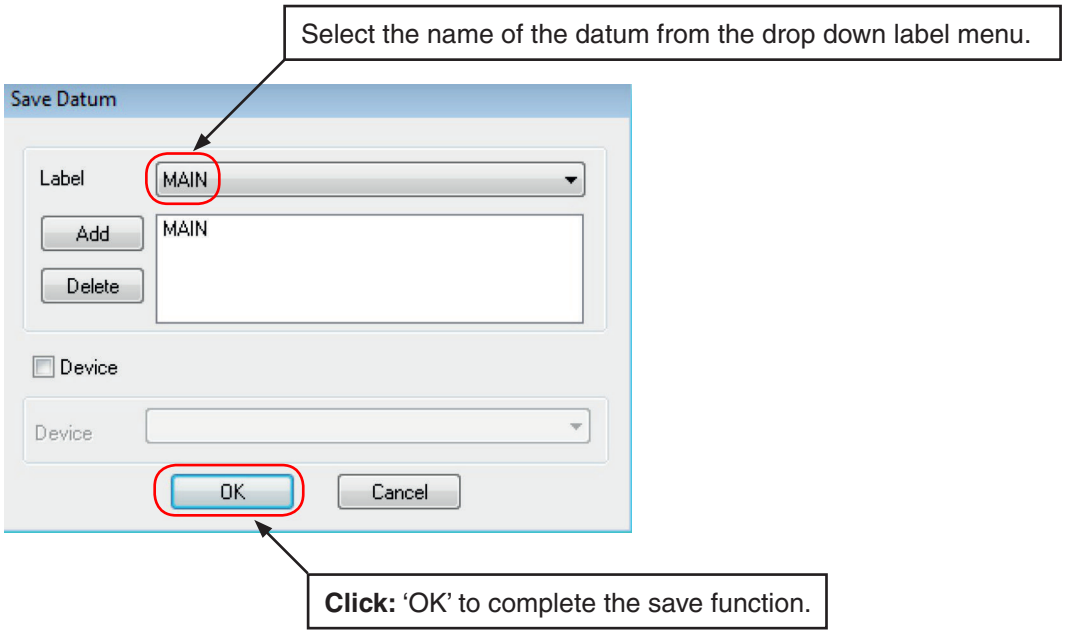


In this case the constructed line lies along the Y axis.

NOTE: There is also the option of selecting +X/-X or -Y.

The datum should now be saved to enable it to be recalled later if necessary:





THE PART ALIGNMENT IS NOW COMPLETE AND IS READY FOR MEASUREMENT.

NOTE: This is a very basic manual alignment using minimum points and is not accurate enough for good metrology.

Code generated for plane and line through two diameters

```
DMISMN/'Start Template',05.2
FILNAM/'Start Template',05.2
DV(0)=DMESWV/'16,0,1,22'
UNITS/MM,ANGDEC
DECPL/ALL,DEFALT
V(0)=VFORM/ALL,PLOT
DISPLY/TERM,V(0),STOR,DMIS,V(0)
SNSET/APPRCH,5
SNSET/CLRSRF,15
SNSET/DEPTH,0
D(0)=DATSET/MCS
MODE/MAN
T(CORTOL_X1)=TOL/CORTOL,XAXIS,-0.1,0.1
T(CORTOL_Y1)=TOL/CORTOL,YAXIS,-0.1,0.1
T(CORTOL_Z1)=TOL/CORTOL,ZAXIS,-0.1,0.1
T(DIAM_1)=TOL/DIAM,-0.1,0.1
 WKPLAN/XYPLAN
 RECALL/SA(TP20_2x20.1.20.2.A0.0-B0.0)
SNSLCT/SA(TP20_2x20.1.20.2.A0.0-B0.0)
 $$<MEAS_PLANE name = "PLN001">
GEOALG/PLANE,DEFALT,ELIMINATE,OFF,FILTER,OFF
MODE/MAN
F(PLN001)=FEAT/PLANE,CART,0,92.5,0,0,0,1
MEAS/PLANE,F(PLN001),3
PTMEAS/CART,2.86,-54.997,0,0,0,1
PTMEAS/CART,53.712,11.69,0,0,0,1
PTMEAS/CART,-52.337,16.459,0,0,0,1
ENDMES
$$<\MEAS_PLANE = PLN001>
 DATDEF/FA(PLN001), DAT(A)
D(Top_Face)=DATSET/DAT(A),ZDIR,ZORIG
 $$<MEAS_CIRCLE name = "CIR001">
MODE/MAN
F(CIR001)=FEAT/CIRCLE,INNER,CART,0,0,-2.309,0,0,1,80
MEAS/CIRCLE,F(CIR001),3
PTMEAS/CART,40,0,-2.309,-1,0,0
PTMEAS/CART,-20,34.641,-2.309,0.5,-0.866,0
PTMEAS/CART,-20,-34.641,-2.309,0.5,0.866,0
ENDMES
$$<\MEAS_CIRCLE = CIR001>
$$<MEAS_CIRCLE name = "CIR002">
MODE/MAN
F(CIR002)=FEAT/CIRCLE,INNER,CART,0,34.5,-10,0,0,1,7
MEAS/CIRCLE,F(CIR002),3
PTMEAS/CART,3.5,34.5,-10,-1,0,0
PTMEAS/CART,-1.75,37.531,-10,0.5,-0.866,0
PTMEAS/CART,-1.75,31.469,-10,0.5,0.866,0
ENDMES
$$<\MEAS_CIRCLE = CIR002>
F(LINE001)=FEAT/LINE,UNBND,CART,0,17.25,-6.155,0,0.976,-0.218,0,0.218,0.976
CONST/LINE,F(LINE001),BF,FA(CIR001),FA(CIR002)
DATDEF/FA(PLN001), DAT(B)
DATDEF/FA(LINE001), DAT(C)
DATDEF/FA(CIR001), DAT(D)
D(MAIN)=DATSET/DAT(B),ZDIR,ZORIG,DAT(C),YDIR,DAT(D),XORIG,YORIG
SAVE/DA(MAIN)
```

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H-1000-5312-01